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Modeling the dynamic habitat and breeding population of Southwestern Willow Flycatcher

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ABSTRACT

To aid in the management and conservation of Southwestern Willow Flycatcher (*Empidonax traillii extimus*, hereafter "Flycatcher"), we developed numerous models of flycatcher breeding habitat at Roosevelt Lake, AZ. For model development and testing, we compiled 10 years of flycatcher territory data that were obtained from intensive fieldwork between 1996 and 2005. We identified riparian vegetation annually in the project area from Landsat Thematic Mapper images, and extracted floodplain features from a digital elevation model. We created a novel class of temporal (i.e., multiyear) variables by characterizing the stability and variability in breeding habitat over a 6-year time interval. We used logistic regression to determine associations between environmental variables and flycatcher territory occurrence, and to test specific hypotheses. We mapped the probability of territory occurrence with a GIS and determined model accuracies with a classification table and a 10-year population database. Environmental features that were associated with breeding flycatchers included floodplain size, proximity to water, and the density, heterogeneity, age and stability of riparian vegetation. Our best model explained 79% of the variability in the flycatcher breeding population at Roosevelt Lake. The majority of predicted flycatcher habitat formed between 1996 and 2004 on an exposed lakebed ~3 years after water levels receded during a prolonged drought. A high correlation between annual reservoir levels and predicted breeding habitat ($r = -0.82$) indicates that we can create and manage habitat for conservation purposes. Our predictive models quantify and assess the relative quality of flycatcher breeding habitat remotely, and can be used to evaluate the effectiveness of habitat restoration activities. Numerous techniques we developed can be used to characterize riparian vegetation and patch dynamics directly off of satellite imagery, thereby increasing its utility for conservation purposes.

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1. Introduction

Riparian habitats in the southwestern United States are disproportionately important for wildlife. For example, over 50% of Southwestern birds are directly dependent on riparian habitat while it only covers about 1% of the landscape (Knopf et al., 1988; Skagen et al., 1998). Unfortunately, riparian habitat has declined by as much as 90% in historic times, and is generally considered a habitat of great conservation and management concern (Busch and Smith, 1995; Comer et al., 2003; Turner et al., 2003; Rich et al., 2004). Many stressors have contributed to the decline of riparian habitat, but one of the most wide-scale stressors to riparian systems is due to dams (Graf, 2006). Dams disrupt the natural flood cycle that riparian systems have adapted to, creating rivers that flood infrequently, lose their meanders, and generally become more channelized (Graf, 2006; Webb and Leake, 2006). However, while much attention has been directed at the down-stream effects of dams, reservoirs can allow for rich riparian habitat to exist along their up-stream fringes. In the U.S. Southwest, many reservoirs fluctuate depending on regional patterns of precipitation, and given the right geomorphology of a reservoir basin, large tracts of riparian habitat can form in the reservoir beds and fringes, especially near inflows. Lowering reservoir levels expose soil that is rich in nutrients, cleansed of salts, and free of existing vegetation that allows for rapid growth of riparian vegetation. Conversely, rising reservoir levels destroy this habitat, setting the stage for a repeat during the next drawdown.

The cycle of creation–destruction caused by fluctuating reservoir levels, reminiscent of the once-frequent scouring flood events of major rivers in pre-dam times, can create large swaths of dense riparian habitat at relatively young successional stages. When this occurs, the riparian habitat is quickly colonized by wildlife, particularly vagile species such as birds, and can become important habitat for the period of time that it exists. One species of great

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